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ABSTRACT AMENDMENTS

Multiple criteria are monitored and controlled to enhance the success of direct-metal deposition, including greater control over factors such as deposit layer height/ thickness, sub-harmonic vibration, contour path shape, powder mass flow, and deposition speed, and stress accumulation. Sensors are used to monitor some or all of the following parameters during the deposition process: deposit height, width, temperature, and residual stress. A predetermined limit with respect to the yield strength of the material is preferably set. If the stress exceeds that limit sensors will automatically introduce one or more remedial measures, the priority of which is established using a look-up table generated in accordance with prior experimental knowledge. To control temperature induced distortion and stress, an infrared temperature detector may be used in conjunction with a controller to reduce temperature, increase speed and decreased power for purpose of stress management. ~~To monitor crack initiation, acoustic emission, infrared temperature and eddy current methods are preferably employed, whereas to monitor the mixing at the interface for multiple material deposition, relative line emission spectroscopy is preferably used. To enhance throughput, multiple nozzles are preferably employed to independently control speed and deposit dimension in a closed loop arrangement so that complicated features may be constructed with close tolerances, so as to improve lead time and design flexibility.~~